CONTROLLER PLACEMENT MECHANISM IN SOFTWARE DEFINED NETWORK USING K-MEDIAN ALGORITHM

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2016

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Abstrak

SDN memisahkan satah kawalan dengan sata data melalui pemindahan satah kawalan ke entity lain. Pemisahan ini menimbulkan beberapa masalah, antaranya penempatan pengawal dalam rangkaian. Kajian ini bertujuan untuk mengkaji penempatan node kawalan dalam SDN. Kadeah k-median digunakan untuk menentukan kududukan nod pengawal, dan nod pengawal dengan purata kependaman terendah akan dipilih. Penentu kedudukan ini akan membandingkan algoritma greedy yang mengira kombinasi berdasarkan kedudukan nod dan mengira nilai terbaik untuk setiap turutan. Kajian ini turut menbandingkan kombinasi keputusan melalui kedudukan nod tertentu, dan keputusan menunjukkan kaedah k-median memberikan nilai yang lebih tinggi. Tiga nod pengawal dipilih sebagai bilangan nod minima and dinilai dari segi kelewatan dan beban, dan keputusan menunjukkan tiga nod memadai sekiranya tiada kelewatan atau bebenan dalam rangkaian.

Kata kunci: SDN; Pengawal; Penempatan; Purata Kependaman; K-median

Abstract

Software Defined Network (SDN) decouples the control plane and the data plane, and moves the control plane to an external entity. The decoupling raises many challenges, and one of these is the placement of the controller in the network. This study aims to address controller placement problem in SDN. k-median is used to determine the placement of the controllers, and the placement with the lowest value of average propagation latency will be chosen. The placement compares two resulted placements. First, comparing to greedy algorithm that computes the combinations according to the order of the nodes and calculates the best values at each step, and the results were identical. The second comparison was with the combinations results from considering the placement from specific nodes, and the results showed that it gives higher results than depending on the lowest values resulted from the k-median. Finally, three controllers are chosen as the minimum number of controllers, they were evaluated in terms of delay and load, and as results it was found that three controllers are suitable number of controllers as long as there is no delay or load in the network. Combining the two algorithms for finding the placement and the number results in Controller Placement Mechanism (CPM)

Keywords: SDN; Controllers; Placement; Average propagation latency; K-median

Acknowledgement

In the name of ALLAH, Most Gracious, Most merciful

All thanks and praises to Allah (SWT) for the blessings of life and for guiding me through studies and life.

My sincere appreciation goes to my supervisors, Dr. Adib Habbal and Mr. Suwannit Chareen Chit, for your patient guidance and encouragement through this research, without your valuable support, this research will not be possible, Thank you.

To my parents, without your love and support I would not be able to continue my studying, I'm so grateful for always believing in me, encouraging me, and never let me doubt myself, I love you, may ALLAH continue to bestow his blessings on you.

To the examiners committee, I'm grateful for your guidance and remarks to make this research better.

To UNIVERSITI UTARA MALAYSIA for giving the opportunity to further my study, and to make my master journey enjoyable and memorable, you have my sincere gratitude.

To my family and friends, thank you for all your support and praying.

Dedication

To my family.

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List of Abbreviations

SDN	- Software Defined Network
CPM	- Controller Placement Mechanism
NOS	- Network Operating System
FD	- Forwarding Devices
DP	- Data Plane
SI	- Southbound Interface
CP	- Control Plane
NI	- Northbound Interface
MP	- Management Plane
API	- Application Program Interface
CPP	- Controller Placement Problem
CCPP	- Capacitated Controller Placement Problem
RCP	- Reliability aware Controller Placement
SA	- Simulated Annealing
POCO	- Pareto-based Optimal COntroller placement
PSA	- Pareto Simulated Annealing
GreCo	- GREEN CENTRALIZED CONTROLLER
BIP	- Binary Integer Program
MC	- Main Controllers
SC	- Slave Controllers
AVL	- Average Propagation latency
MyREN	- Malaysian Research & Education Network
MoE	- Ministry of Education
MDeC	- Multimedia Development Coperation
UITM	- Universiti Teknologi MARA

UTP	- Universiti Teknologi Petronas
UUM	- Universiti Utara Malaysia
UM	- University of Malaya
UNIMAS	- Universiti Malaysia Sarawak
UMS	- Universiti Malaysia Sabah
IUM	- International Islamic University Malaysia
UPSI	- Sultan Idris Education University
UPM	- Universiti Putra Malaysia
UTHM	- Universiti Tun Hussein Onn Malaysia
UTM	- University of Technology, Malaysia
UMT	- Universiti Malaysia Terengganu
UMK	- Universiti Malaysia Kelantan
UDM	- Universiti Darul Iman Malaysia
UMP	- Universiti Malaysia Pahang
UPNIM	- National Defence University of Malaysia
UTEM	- Universiti Teknikal Malaysia Melaka
NOC	- Network Operation Center
UKM	- National University of Malaysia
MMU	- Multimedia University
USIM	- Universiti Sains Islam Malaysia
UNITEN	- Universiti Tenaga Nasional
MIMOS	- Malaysia's national R&D centre in ICT
TMRND	- Telekom Research & Development
MOHE	- Ministry of Higher Education
USM	- Universiti Sains Malaysia
UNIMAP	- Universiti Malaysia Perlis

CHAPTER ONE

INTRODUCTION

1.1 Overview

The current network schemes are complex and very difficult to manage. Predefined policies make the network difficult to be configured and also very hard to reconfigured so that it can respond to the load, faults and changes in the network (Open Networking Foundation, 2012). Current networks are integrated vertically where the control plane (that decides how to handle the traffic), and the data plane (that forwards the traffic based on the decision of the control plane) are coupled together which lead to the reduction of the flexibility as well as holding back the innovation and the network infrastructure evolution.

Software Defined Network (SDN) has gotten a lot of attention recently as a solution to overcome the limitations of the current network schemes. According to the Open Networking Foundation, " the SDN architecture, the control and data planes are decoupled, network intelligence and state are logically centralized, and the underlying network infrastructure is abstracted from the applications" (Open Networking Foundation, 2012). Based on this definition (Sezer et al., (2013)) extracted four features which are: the control plane and the data plane are separated, interfaces are open between the data plane and the control plane, the controller is centralized, and the network programmability by external applications.

Kreutz et al., (2015) defined SDN as an architecture for the network that has four pillars: First, the separation of the control plane and the data plane. The controller

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